

INJURIES OF THE MAIN BLOOD-VESSELS IN  
THE AXILLA CAUSED BY EFFORTS  
TO REDUCE DISLOCATIONS OF  
THE SHOULDER.<sup>1</sup>

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DISLOCATION of the shoulder, an injury, both relatively to the other dislocations and actually, common, is, at least when recent, deemed one of minor gravity, the cure of which can be effected readily and without risk to the patient. But, from time to time, cases are reported in which the gravest consequences have followed reduction or the attempt to reduce, and such accidents have happened and continue to happen in the practice of even the most experienced surgeons, aided by anæsthetics and employing methods of manipulation rather than those of force. The importance of the general recognition of this possibility, the interest attaching to certain questions of diagnosis and treatment, and the discovery of certain errors current in the statistics of the subject, have led me to bring before you a question which, within the last few years, has been the theme of several writers, and with which all are reasonably familiar.

Among these accidents, the most frequent and most important are those of injury to the main blood-vessels in the axilla.

Although the earliest recorded cases of this accident occurred at about the beginning of the eighteenth century, the subject did not receive the attention of systematic writers on surgery until after the publication, in 1827, of an article by

<sup>1</sup> Read before the New York Surgical Society, May 26, 1882.

Flaubert.<sup>1</sup> Malgaigne, in 1855, discussed the subject at length in his work on dislocations, mentioning sixteen cases of all kinds, certain and uncertain. Callender,<sup>2</sup> taking as a text his own fatal case, again collected and collated the known cases; and similar use was made of the material, and other cases added to the list by Le Fort,<sup>3</sup> Willard,<sup>4</sup> and Marchand.<sup>5</sup> In 1882 Körte<sup>6</sup> reported three personal cases, and wrote a very full and valuable paper on the subject containing forty-four supposed (actually thirty-eight; see note below) cases of dislocation of the shoulder, in which the vessels had been seriously injured during the act of dislocation or of reduction; and in 1884 Cras<sup>7</sup> reported a personal case of injury of the axillary artery, and added a few others to Körte's list. Strictly speaking, several of these cases should not be here considered, since in them the vessel was injured at the moment of dislocation and not during reduction, and in many others it remains uncertain whether the same objection might not be made to them. They are retained because they serve equally well with the others to further the study of most features of the subject.\*

<sup>1</sup> "Mém. sur plusieurs cas de luxations dans lesquels les efforts pour la réduction ont été suivis d'accidents graves," *Répertoire d'anat. et de phys.*, 1827.

<sup>2</sup> "St. Bartholomew's Hosp. Reports," vol. ii, 1866, p. 96.

<sup>3</sup> "Dict. encyclopédique des sci. méd." Article *Axillaires*.

<sup>4</sup> "Phila. Med. Times," 1873, vol. iii, p. 721.

<sup>5</sup> "Des accidents qui peuvent compliquer la réduction des luxations traumatiques," *Thèse de concours*, Paris, 1875.

<sup>6</sup> "Arch. für klinische Chirurgie," vol. xxvii, p. 631.

<sup>7</sup> "Bul. de la société de chirurgie," 1884, p. 739.

\* Reference to the original accounts, so far as I have been able to obtain them, shows several errors in the lists given by the above-mentioned writers. Sir Astley Cooper's case must be excluded because it is the same as Gibson's first case, having been simply quoted by Cooper without acknowledgment.

Blackman's case must be excluded because it proved to be not a dislocation, but a fracture of the humerus. As it has been widely quoted, and is, indeed, given in detail as a dislocation by Dr. Hamilton ("*Fract. and Disloc.*"), an explanation of the manner in which the error arose may be of service. Blackman reported it as a dislocation in the "*Western Lancet*," August, 1856, p. 469, and an abstract of this report was given in the "*American Journal of the Medical Sciences*," 1856, vol. xxii, p. 371, and is quoted by most writers. But on page 508 of the same (August) number of the "*Western Lancet*" is a note by Blackman, which apparently had been overlooked by the maker of the abstract, giving the results of the autopsy and showing the error in the diagnosis. The fracture was at the surgical neck, and the end of the shaft had been displaced upward and lay in contact with the coracoid pro-

The trustworthy recorded cases of injury to the larger vessels of the axilla in dislocation or reduction of dislocation of the shoulder are forty-four in number. Of these, the axillary vein alone was ruptured in three (Frobiep,<sup>1</sup> Price,<sup>2</sup> Hailey<sup>3</sup>), although I think the last one doubtful, and the artery and vein together in two (Platner, <sup>4</sup> Baum<sup>5</sup>). In most of the others the axillary artery or one of its branches was injured, but in some the source of the hæmorrhage remains uncertain. In thirty-two cases death or amputation of the arm furnished the opportunity to examine the region and determine the character of the lesion; this, in some cases, was a complete or partial rupture of all the coats of the artery, or of the inner and middle coats alone, with subsequent formation of a circumscribed aneurysm.<sup>6</sup> In other cases the vitality of the wall appears to have been diminished or destroyed by direct pressure, and this to have been followed, after the lapse of a few days, by rupture (Warren<sup>7</sup>), or still later, by the formation of an aneurysm. In Gibson's second case<sup>8</sup> an aneurysm appears to have

<sup>1</sup> Malgaigne, "*Luxations*," p. 151. <sup>2</sup> Callender, *loc. cit.*, p. 107. <sup>3</sup> "*British Medical Journal*," 1865, ii, p. 634.

<sup>4</sup> Malgaigne, *loc. cit.*, p. 151. <sup>5</sup> "*Deutsche Klinik*," 1867, p. 431.

<sup>6</sup> It is possible that this rupture may be followed by obliteration of the artery at the wounded part. Scarpa held this opinion (Hodgson, "*Dis. of Arteries*," p. 488.)

<sup>7</sup> "*Med.-Chirurg. Trans.*," vol. xxix, p. 25.

<sup>8</sup> "*Surgery*," vol. i, p. 334.

cess; the head was still in the glenoid cavity, and had partly united with the shaft about an inch below its upper end.

In Segond's case not only does the artery appear to have been wounded by a piece of the dish the patient was carrying, but it is doubtful even if the limb was dislocated.

In Delpach's case it is recorded only that at the moment of reduction the patient grew pale, became unconscious, and died immediately, and there is nothing to show the cause of death.

In Fano's, the artery may have been simply compressed. O'Reilly's is the same as Adams'. The latter admitted the case into hospital, the former operated upon it.

A case which Callender quotes, a man treated by a "bone-setter," does not deserve to be grouped with those treated by professional surgeons, although the force employed—traction by twelve or eighteen assistants—was not much in excess of that recorded in some of the other cases, or of what I have myself seen employed. Not only the artery, but also the muscles were torn and the humerus was broken.

Green's case ("*Lancet*," vol. viii, pp. 189 and 283) is quoted as one of recovery after ligature of the subclavian, but the reports end on the eighteenth day with the ligature still in place, and after a free hæmorrhage on the thirteenth day.

formed in consequence of the earlier attempts to reduce, and then itself to have been ruptured when Gibson effected reduction. Rupture appears always to have taken place quite high up, and usually at the point pressed upon by the head of the humerus. Callender found it necessary to divide the pectoralis minor to reach it. In the fatal cases of injury of the vein alone the vessel was torn completely, or almost completely, across. In Baum's case both artery and vein were partly torn by a broken piece of the new bony socket that had formed about the head of the humerus. The artery was tied above the origin of the long thoracic, and a second ligature was subsequently placed on it at the level of the lower border of the pectoralis major.

In five cases (Callender, Desprès,<sup>1</sup> and Körte's three) only a small (one-sixth of an inch) oval opening was found on the anterior wall of the artery, and was thought to have been produced by the tearing off of a branch, the subscapular or circumflex.

In Gärtner's<sup>2</sup> case the opening in the artery is described as funnel-shaped, but the tumor was small, formed slowly, and presented the common signs of aneurysm, so that it seems probable that what he describes as the opening included also the neck of an aneurysmal sac. In other cases the subscapular (Lefevre<sup>3</sup>) or the circumflex artery (von Pitha<sup>4</sup>) was torn across at or near its origin. These last-named eight cases form a considerable proportion of the whole number, and are of great importance because they explain the persistence of the radial pulse noted in several of the histories.

Of twenty-nine cases in which the age of the patients is given, in twenty they were more than forty years old. The youngest was twenty (Gärtner), the oldest eighty-six (Sands<sup>5</sup>). In very few of the cases is it noted that the arteries were atheromatous, although the advanced age of many of the patients makes it probable that the elasticity of the vessels was diminished.

<sup>1</sup> "Bull. de la soc. de chirurgie," 1878, p. 116.

<sup>2</sup> "Schmidt's Jahrbüch.," 1871, vol. cli, p. 304.

<sup>3</sup> Cras, *loc. cit.*, p. 750.

<sup>4</sup> Körte, *loc. cit.*, p. 649.

<sup>5</sup> N. Y. Medical Record, 1880, p. 45.

In more than half the cases the dislocation was recent—less than three weeks. In not more than one-third of them is it reasonably certain that the lesion was caused during reduction; in three cases it was certainly caused by the dislocation; in the remainder the cause is obscure. To these latter belong those cases in which the reduction was promptly effected, and without the use of much force or of exaggerated positions of the arm.

In many of the others the attempt to make reduction was greatly prolonged or several times repeated, and the force used was very great or improperly applied. This last criticism is probably applicable to the earliest four cases (Verduc, Petit, Platner, Bell), about which nothing is known except that death was caused by hæmorrhage. In one of them (Bell<sup>1</sup>) the use of the ambi is mentioned, and it is probable that it or the method of the door or ladder was employed in all.

In some the injury was evidently caused by excessive traction (Gibson, traction by five or six assistants in one case, by pulleys for nearly two hours in the other; Leudet, eight assistants); in others by faulty manœuvres, such as extreme abduction or elevation of the arm, rotation and circumduction; in others again apparently by direct compression of the vessel against the underlying bone, as by the booted heel in the axilla (Warren, Rivington<sup>2</sup>), or possibly by the thumbs (Panas<sup>3</sup>).

Leaving aside the earlier cases in which faulty methods no longer in use were employed, and those old dislocations in which the relations and connections had been permanently changed by fibrous or bony tissue of new formation, it becomes evident that in dislocation of the shoulder the accident is most to be apprehended when the elbow is raised in abduction to the height of the shoulder, or is carried, as in Callender's case, across the chest and face in a wide movement of circumduction; and for this reason, that in these movements the dislocated head of the bone is turned downward into the axilla, and the vessels which lie upon its inner side are pressed down before it and forcibly put upon the stretch, while those branches

<sup>1</sup> Callender, *loc. cit.*, p. 101.

<sup>2</sup> "*British Medical Journal*," 1872, i, p. 420.

<sup>3</sup> Marchand, *loc. cit.*, p. 52.

which run almost directly outward, the subscapular and circumflex, and are fixed to the tissues amid which they branch, are directly and forcibly elongated. Even when the head of the humerus is in its socket the axillary vessels are put upon the stretch when the arm is widely abducted, and can be readily verified during an operation for the removal of the axillary glands, or, still more simply, by observing the arrest of the radial pulse when the arm is raised and carried backward; and there are several cases on record in which this movement alone has resulted in the formation of an axillary aneurysm or in rupture of the axillary artery.<sup>1</sup> Although in dislocation inward the limb is shortened by being abducted, yet the artery is not thereby relaxed, but, on the contrary, it is still further stretched around the head of the bone. Jössel,<sup>2</sup> in a recent case in which death was caused by associated injuries, found the "nerves of the brachial plexus, especially the circumflex nerve and the subscapular artery, greatly stretched by the head of the humerus," and, according to Körte (*loc. cit.*, p. 640), he found in another case of recent dislocation the subscapular artery torn.

In his remarks on the case at the Sheffield Infirmary<sup>3</sup> in which the artery was torn across during an unsuccessful attempt to reduce a dislocation of six weeks' standing, and an incision was made through which each end of the torn artery was tied, Mr. Jackson says: "One thing was noticed on cutting into the axilla: the extreme tension caused by the pressure of the head of the humerus on the vessels and nerves when the arm was raised above the shoulder." This patient died two days after the operation.

In some of the cases in which it is certain or probable that the injury to the vessel was inflicted at the moment of dislocation, it is noted that the latter was produced while the arm was widely abducted—that is, under circumstances in which the head of the humerus would be driven downward and inward.

<sup>1</sup> Cases of Pelletan and Paget, and specimen in museum of St. George's Hospital; Callender, *loc. cit.*, pp. 103 and 107.

<sup>2</sup> "*Deutsche Zeitschrift*," vol. xiii, 1880, p. 177.

<sup>3</sup> "*British Medical Journal*," Feb. 3, 1883, p. 207.

If the dislocation is an old one, and especially if there has been much inflammatory reaction and the vessels have become firmly adherent to the bone or imbedded in unyielding cicatricial tissue, the liability to rupture is increased because of the loss of elasticity occasioned by the latter condition, and because of the limitation of the strain to a shorter segment of the vessel in the former. If, in addition, the distensibility of the vessel has been further reduced by atheroma, the danger is still greater; and this last predisposing cause may properly be deemed sufficient to lead to the rupture even when the traction is slight and the manœuvres are confined within a narrow range.

In Anger's<sup>1</sup> case, fracture of the head (?) of the humerus co-existed; in Mash's<sup>2</sup> two pieces had been chipped off the head of the humerus, and were lying in the glenoid cavity. In several others fracture of the greater tuberosity of the humerus or of the rim of the glenoid cavity is noted; the former of these two complications is common in inward dislocation of the humerus, and could have had no direct influence in causing the injury of the vessels; the latter, also, was probably without influence, since the vessels are pushed away from the scapula, and the fragment remains attached to it.

The *symptoms* at the beginning present two widely different forms; in one, the less common, a tumor presenting many of the signs of an encysted aneurysm appears in the axilla a few days or weeks after the reduction, and increases in size rather rapidly; if not successfully treated, it soon involves the skin and ruptures externally. In the other form, the more common, a diffused fluctuating swelling, without bruit or pulsation, appears immediately, or within a few hours, in the axilla, raising the pectoral and deltoid muscles, or is, perhaps, most prominent posteriorly, and in most cases promptly reaches a large size, even that of the adult head (Lister<sup>3</sup>); the radial pulse sometimes persists. The only exception to rapid growth among the recorded fatal cases is Körte's third case (*loc. cit.*,

<sup>1</sup>"*Bull. de la soc. de chirurgie*," 1878, p. 122.

<sup>2</sup>"*British Medical Journal*," 1872, i, p. 526. Reported by Carruthers, the house surgeon.

<sup>3</sup>"*Edinb. Medical Journal*," 1873, p. 829.

p. 636), in which the extravasated blood disappeared slowly, leaving a firm, non-pulsating lump, as large as a walnut, in the course of the axillary artery, which a surgeon supposed to be a lymphatic gland, and undertook to extirpate nearly five months after the accident. It proved to be an aneurysm containing much stratified clot; the axillary artery was tied above and below, and the patient died.

In several cases the patients died promptly after the accident, sometimes after profound syncope, sometimes (Gibson's first case<sup>1</sup>) after a short period of apparent well-being, with symptoms of shock or acute anæmia. In two, which finally ended in recovery (Sands, Agnew,<sup>2</sup>), the patients were at first greatly prostrated, and death by syncope threatened. In another (Mash's) emphysema developed in the arm, and the patient died forty hours after the reduction. In this case the inner and middle coats of the artery were torn across "just beyond the point of origin of the dorsal scapular branch." The radial pulse was at first perceptible, but had ceased the next morning.

In most of the others the swelling increased, and, in a longer or shorter time, ruptured spontaneously, or was threatening to rupture when operative interference (puncture, incision or ligation of the subclavian) was resorted to. The longest period was in Bellamy's<sup>3</sup> case, six months after reduction, and even in this case the first hæmorrhage occurred five weeks after reduction.

In the cases that recovered without operation (Agnew, Sands, Malgaigne,<sup>4</sup> Desault,<sup>5</sup> Anger, Nélaton's second case<sup>6</sup>) the swelling subsided, and the ecchymosis was slowly absorbed. Agnew's patient was discharged in ten days, Anger's and Desault's in a fortnight, Malgaigne's was well on the twenty-second day, and Sands', a woman 86 years old, made a slow recovery. In

<sup>1</sup> "*Surgery*," vol. i, p. 325.

<sup>2</sup> Willard in "*Phila. Med. Times*," vol. iii, 1873, p. 721.

<sup>3</sup> "*Lancet*," ii, 1880, p. 260.

<sup>4</sup> *Loc. Cit.*, p. 150. <sup>5</sup> "*Œuvres chirurgicales*," i, p. 380. \* Referred to by Anger and Le Fort, *loc. cit.*

three of them (Nélaton's, Anger's, and Sands's<sup>1</sup>) the diagnosis of rupture of the axillary artery was made. Desault's diagnosis was "emphysema of the cellular tissue"; he had reduced by violent and prolonged traction a dislocation of six weeks' standing in a man sixty years old. At the moment of reduction a tumor formed suddenly under the pectoral muscle, and soon filled the axilla; the patient fainted, and the pulse was barely perceptible on the affected side; the tumor was well defined, elastic, not fluctuating, the overlying skin was not at first discolored, and percussion gave a sort of sound (*espèce de bruit*). On these symptoms rupture of the artery was excluded, and the diagnosis of emphysema made. Malgaigne and Agnew made the diagnosis of rupture of the axillary vein.

I think there is reason to doubt the correctness of the diagnosis in the last three cases, certainly in Desault's and Malgaigne's, for it was avowedly based on the persistence of the radial pulse, and, although it is not so stated in the report of Dr. Agnew's case, it seems fair to assume that the same persistence of the pulse which is noted in the report was also the basis of his diagnosis. As has been already mentioned, rupture of the subscapular or circumflex artery has several times presented similar symptoms, and, as in Mash's case just quoted, the radial pulse may even persist after rupture of the inner and middle coats of the axillary artery itself. Pelletan<sup>2</sup> had a case similar to Desault's, made the same diagnosis, and incised the tumor; the patient died of hæmorrhage, and the artery was found to have been ruptured.

In the two cases in which rupture of the vein alone was demonstrated post mortem (Froriep. Price), the patients died promptly, in an hour and a half and on the following day, respectively. In the third case Hailey's, in which this lesion is said to have been proved by the autopsy, the account of the examination is very unsatisfactory, and leaves it, I think, quite uncertain what the actual injury was. The patient was a man fif-

<sup>1</sup> Dr. Sands's patient died in May, 1885. The injury proved to have been of the axillary artery, which was occluded at a point a quarter of an inch above the origin of the posterior circumflex. The specimen was presented at the meeting of the New York Surgical Society, at which this paper was read, and a description of it will be found in the report of the proceedings.

<sup>2</sup> *Clinique chirurgicale*, vol. ii, p. 95. Quoted by Malgaigne.

ty-nine years old; the dislocation was caused by a fall from a wagon and was very easily reduced. The symptoms were, first, pain in the wrist, then, after a few days, swelling of the shoulder and œdema of the arm; at the end of two months a tumor appeared between the acromion and coracoid (*sic*), and death by exhaustion a few days later. The tumor was blood-clot, more than two pounds being removed from the axilla.

In De Morgan's case<sup>1</sup> "it was impossible to detect the source of the hæmorrhage" at the autopsy, and it was attributed to the rupture of many and small veins. This explanation also, I think, may well be questioned, for in this case too the radial pulse persisted, and at that time no cases had yet been reported in which similar symptoms had been shown to be caused by rupture or avulsion of a branch of the main artery. If, as seems probable from the account and in view of the ignorance of this fact, the examination was mainly directed to the condition of the veins, it is not unlikely that rupture of an arterial branch may have been overlooked, especially since the symptoms were not unlike those of some of the other cases in which this rupture was demonstrated (Desprès, Körte's second case). The symptoms and course of this case were, in brief, as follows:

The patient was a man 54 years old, the dislocation subcoracoid, the reduction immediate, under chloroform, with the heel in the axilla. During the first week "there was nothing to be noticed but the ordinary swelling attending such a dislocation. This swelling, instead of subsiding, increased, and this somewhat rapidly toward the end of the first week. There was also some purple discoloration about the inner and posterior parts of the shoulder. Still, there were no appearances which might not attend an ordinary bruise or laceration about the part. But, in the course of the following week, enormous swelling had come on, extending from the elbow up the arm and over the chest to the level of the outer third of the clavicle, and over the scapula." The swelling was soft and fluctuating; the skin in places dark purple and thin; the radial pulse was natural. Fever, with slight shivering and one dis-

<sup>1</sup> "British Medical Journal," 1872, i, p. 5.

tinct chill. "About the third or fourth week an incision was made in the arm and the hand passed up into the cavity, which contained an enormous amount of blood, chiefly coagulated, extending under the pectoral muscles, down the side of the chest, and behind over a great part of the scapula, and communicating with the shoulder joint. The subclavian and axillary arteries could be felt." The man died with symptoms of septicæmia.

In Körte's second case (*loc. cit.*, p. 635) the patient was 52 years old, the dislocation forward and inward. Several unsuccessful attempts to reduce were made during the sixth month, and the last was followed by the gradual appearance of a non-pulsating swelling under the pectoral muscle, œdema of the arm, and sharp neuralgic pain. Radial pulse. The patient became feverish, the tumor softer, the skin thin, and at the end of six weeks it ruptured spontaneously. The hæmorrhage was arrested with a tampon, and the patient died shortly afterward. The autopsy showed a large cavity occupying all the space under the pectoralis major, and filled with large blood-clots. On the outer and front side of the artery, 4 centimetres below the clavicle, was a transverse oval opening measuring 0.4 by 0.3 centimetre (one-sixth by one-eighth inch), thought (*loc. cit.*, p. 650) to have been produced by the tearing off of an arterial branch.

In Després's case there was the same swelling, slowly increasing and becoming fluctuating, œdema of the arm, and persistence of the radial pulse. In addition, a bruit was audible after the tenth day, and the swelling subsequently pulsated at times. An operation for ligature of the subclavian was done on the forty-fifth day, and was followed by arrest of the pulsation, but, after the patient died, on the fifty-fourth day, it was found that the ligature had been placed upon a nerve immediately overlying the artery. The common trunk of the circumflex arteries was found to have been torn off at its origin.

On the other hand, in Körte's first case, in which the lesion proved, post mortem, to be a similar opening upon the side of the axillary artery, and of almost exactly the same size, pulsation in the brachial and radial arteries was barely per-

ceptible two months after the accident, when the patient first came under observation with an enormous pulsating swelling of the shoulder, filling the axilla and extending up to the clavicle.

These histories show, and many of the others might be quoted in confirmation, that, although the diagnosis, so far as the general nature of the accident, rupture of blood-vessel, is concerned, does not long remain obscure; the identity of the injured vessel can not always be determined. If the tumor pulsates, the diagnosis of rupture of an artery may be made; and if, in addition, the radial pulse is present, it is extremely probable that the injured vessel is not the main artery, but that one of its branches, probably the subscapular or circumflex, has been ruptured or torn off at its origin. Beyond this it does not seem at present possible to go with much certainty, although the great preponderance of arterial lesions in the known cases—26 out of 28, or, adding Hailey's and De Morgan's, out of 30, or, again, adding Platner's and Braun's, in which both artery and vein were torn, out of 32—makes it highly probable in any given case that an artery and not the axillary vein has been torn.

Of the remaining 12 cases, 6 recovered without operation (Desault, Malgaigne, Nélaton's second case,<sup>1</sup> Anger, Agnew, Sands) and have been already discussed. Nélaton, Anger, and Sands made the diagnosis of rupture of an artery. In the other 6—Warren, O'Reilly,<sup>2</sup> Green, Volkmann,<sup>3</sup> Létiévant,<sup>4</sup> Cras—the subclavian was tied; in 5 of them with success; in 1, Green's, the result is not known.

In the last 6, and in 3 of the first 6, it seems reasonably certain that an artery was injured, for pulsation of the swelling is noted in every account that is given in detail, and such was the opinion of the surgeons who treated them. The record, then, may be made as follows: Of 44 cases, an artery (the axillary or a large branch) was ruptured in 35, the artery and vein in 2, the vein alone in 2, in 2 dissection failed to reveal

<sup>1</sup> After rupture of the tumor without hæmorrhage, and suppuration of the sac and shoulder joint. See Körte, *loc. cit.*, p. 655.

<sup>2</sup> "Cyclopædia of Anat. and Phys.," vol. iv, part 1, p. 616, art. "Shoulder Joint."

<sup>3</sup> Körte, *loc. cit.*, p. 656.

<sup>4</sup> Cras, *loc. cit.*, p. 748.

the source of the hæmorrhage, and in 3, in which the patients recovered without operation, the symptoms do not justify a positive diagnosis.

The *terminations* were as follows: 12 recoveries, 31 deaths, and in 1 (Green's) the result is unknown; 20 received no operative treatment; of these, 6 recovered and 14 died;<sup>1</sup> In 14 the subclavian was tied, with 5 recoveries, 8 deaths, and 1 unknown result. In 6 an incision was made in the axilla, and the artery tied above and below the point of rupture; all died. In 4 the limb was disarticulated; 1 recovery, 3 deaths. The treatment in the cases that recovered without operation was simply compression of the swelling and immobilization of the arm, with the application of ice in Malgaigne's, and compression of the subclavian artery in Agnew's.

In drawing inferences from these results, it must be borne in mind that in many of the cases in which operations were undertaken non-operative treatment had previously been employed, and had resulted in a condition that made an operation necessary. Thus, using only those cases in which the record is sufficiently detailed, of the 14 cases of ligature of the subclavian, in 7 the operation was done after the lapse of several weeks or even months; in 1 on the third day, in one on the tenth day, and in 5 the length of the interval is not known. Of the 4 disarticulations, in 1 the operation was at a late date, in 1 five days after the accident, and in 2 unknown. Of the 6 treated by incision and double ligature of the axillary artery, the operation was done promptly in 2, and after a long interval in 4. Consequently the results of non-operative treatment may be tabulated as follows: Of 32 patients, 6 recovered, 14 died, and 12 (with 10 deaths) subsequently underwent operation, either because death by hæmorrhage threatened, or because of the existence of a growing aneurysm.<sup>2</sup> A fair inference is that conservative treatment may properly be tried at first, but should not be prolonged if the symptoms do not promptly yield; and, secondly, that, in case of resort to operation, ligature of the subclavian artery or disarticulation at the

<sup>1</sup> Possibly Körte's second case should be included among the recoveries.

<sup>2</sup> Körte's second case is an exception; an error in diagnosis led to an operation after the aneurysm had apparently undergone spontaneous cure.

shoulder is to be preferred to incision of the sac and double ligature of the artery.

Experience with arteries wounded under other conditions has shown that they will sometimes quite readily heal, or the opening made into them will close, under pressure accurately made at the point of injury, and it would, therefore, be proper to attempt to treat this injury by direct, limited pressure. Whether or not it would be possible to recognize the wounded point and make efficient pressure directly upon it can not be said, since the attempt does not appear to have been made. In default of such limited pressure, general compression of the swelling in the axilla seems to be the only other resource short of operation. The common treatment of ruptured artery, incision and double ligature of the vessel, was immediately resorted to in only two of these cases, Lister's and the one at the Sheffield Infirmary.<sup>1</sup> Both were promptly fatal.

An important question arises from these facts in connection with the treatment of dislocation of the shoulder: How far does the possibility of the occurrence of this accident affect the choice of a method of reduction? and also concerning the propriety of attempting reduction in cases that are not recent.

In the reduction of recent dislocations, these accidents show that abduction of the arm especially should be avoided, as also circumduction, violent traction, and rough pressure in the axilla. Kocher's method by manipulation appears well adapted to avoid the danger. It is also to be remembered that the injury to the vessel may be caused by the dislocation itself, and its symptoms may be masked by the swelling commonly present during the first few days.

In old dislocations the probability of the occurrence of the accident is increased by the more forcible measures usually necessary to break up the adhesions that bind the bones in their new relations; and, while it may be proper in many cases to make the attempt to restore the limb to usefulness, this possibility creates another reason for abstention when the patient is old, the duration of the dislocation long, and the adhesions firm. Even a dislocated arm may be very useful, and the fatal-

<sup>1</sup> "*British Medical Journal*," February 3, 1883, p. 207.

ity of this accident, more than 70 % of deaths, may well cause the surgeon to hesitate to incur the risk merely for the sake of ameliorating a condition which does not endanger life and is quite compatible with activity and usefulness.

## LIST OF CASES.

A. *Fatal without Operation.*

1. Verduc (Malgaigne, "*Des luxations*," p. 149); artery wounded; no treatment; death by hæmorrhage.
2. Petit (Malgaigne, "*Des luxations*," p. 149); artery wounded; no treatment; death by hæmorrhage.
3. Pelletan (Malgaigne, "*Des luxations*," p. 149); artery wounded; puncture; death by hæmorrhage.
4. Platner (Malgaigne, "*Des luxations*," p. 149); artery and vein; death by hæmorrhage.
5. Leudet (Malgaigne, "*Des luxations*," p. 149); artery; 57 years. Dislocation 11 days.
6. Froriep (Malgaigne, "*Des luxations*," p. 149); vein; 26 years. Dislocation 3 weeks.
7. Gibson, I, "*Surgery*," i, p. 325; 50 years. Disloc. 2 months. Death in a few hours.
8. Price, quoted by Callender; vein. Death on following day.
9. Körte, I, *Arch. für klin. Chir.*, vol. xxvii, p. 631; artery; 25 years. Disloc. recent. Puncture.
10. Körte, III, *Ibid.*; artery; 52 years. Disloc. 5½ months. Rupture.
11. Mash (Carruthers), "*Brit. Med. Jour.*," 1872, i, p. 526; artery; 38 years. Disloc. recent.
12. Hailey, *Ibid.*, 1864, p. 634; 59 years. Disloc. recent.
13. De Morgan, *Ibid.*, 1872, i, p. 54; 54 years. Disloc. recent. Incision.

B. *Ligature of the Subclavian.*

14. Green, "*Lancet*," 1825, vol. viii, pp. 189 and 283; 33 years. Disloc. recent. Result unknown.
15. Warren, "*Med.-Chir. Trans.*," vol. xxix, p. 25; 30 years. Disloc. recent. Recovery.
16. Gibson, II, *loc. cit.*, p. 334; 35 years. Disloc. 9 weeks. Death.
17. O'Reilly (Adams), "*Cyclop. of Anat. and Phys.*," vol. iv, p. 616; 50 years. Disloc. recent. Recovery.
18. Nélaton, I, "*Path. Chir.*," ii, p. 368. Disloc. old. Death.

19. Rigaud, "*Dict. encyclop.*," art *Epaule*; artery; 31 years. Death.
20. Von Pitha (Körte), *loc. cit.*; artery; death.
21. Volkmann, *loc. cit.* Recovery.
22. Panas (Marchand, p. 52); artery. Disloc. recent; death.
23. Desprès, "*Bull. de la soc. de chir.*," 1878, p. 116; artery; 40 years. Recent; death.
24. Gärtner, "*Schmidt's Jahrb.*," 1871, vol. cli, p. 304; artery; 20 years. Recent; death.
25. Létievant. "*Bull. de la soc. de chir.*," 1884, p. 748. Recent; recovery.
26. Lefeuvre, *Ibid.*, p. 750; artery; 52 years. Recent; death.
27. Cras, *Ibid.*, p. 739; 45 years. Recent; recovery.

#### C. Double Ligature—all fatal.

28. Callender, "*St. Barthol. Hosp. Rep.*," vol. ii, p. 96; artery; 61 years. Disloc. old.
29. Wutzer, "*Arch. für klin. Chir.*," vol. x, p. 308.
30. Körte, II, *loc. cit.*; artery; 29 years. Disloc. recent.
31. Lister, "*Edinh. Med. Jour.*," 1873, p. 829; artery 58 years. Disloc. 8 weeks.
32. Rivington, "*Brit. Med. Jour.*," 1872, i, p. 420; artery; 71 years. Disloc. recent.
33. Sheffield Inf., *Ibid.*, 1883, i, p. 207; artery; 62 years. Disloc. 6 weeks.
34. Baum, "*Deutsche Zeitschrift*," 1880, vol. xiii, p. 177; artery and vein. Lig. of axillary (possibly double).

#### D. Disarticulation at Shoulder.

35. Jünken, "*Arch. für klin. Chir.*," vol. x, p. 313; artery. Unsuccessful attempt to apply double ligature; recovery.
36. Bell (Malgaigne and Callender). Death.
37. Ledentu, "*Bull. de la soc. de chir.*," 1877, p. 187; artery. Disloc. recent; death.
38. Bellamy, "*Lancet*," 1880, ii, p. 260; artery; 55 years. Disloc. 7 weeks; death.

#### E. Recovery without Operation.

39. Desault, "*Œuvres chirurgicales*," vol. i, p. 380; 60 years. Disloc. 1½ month.
40. Malgaigne, *loc. cit.*; 44 years. Disloc. 2 months.
41. Anger, "*Bull. de la soc. de chir.*," 1878, p. 122; 54 years.
42. Nélaton, II, *Ibid.*

43. Agnew, "*Phila. Med. Times.*" 1873, p. 721; 60 years. Disloc. 6 weeks.

44. Sands, N. Y. "*Med. Record*," 1860, p. 45; 84 years. Disloc. 7 weeks. Autopsy in the proceedings of the New York Surgical Society, May 26, 1885.